THE EMC EFFECT IN NEUTRINO INTERACTIONS (BEBC D_2 AND Ne)

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The BEBC D_2 (WA25) and Ne (WA59) Collaborations have published results on the cross section ratios $\sigma(\bar{\nu}\text{ Ne})/\sigma(\bar{\nu}\text{ D}_2)$ as a function of x, y and Q^2, in order to investigate any difference in $\bar{\nu}$ scattering on heavy and light nuclear targets [1] (fig. 1,2). The data shows a slope in the range $0.3 < x < 0.6$, similar to that observed by the EMC Collaboration [2] and in new data taken at SLAC [3]. However, at small x, there is no sign of any significant deviation from unity, in agreement with the SLAC data, but in disagreement with the EMC data. This disagreement between SLAC and EMC data sets has been attributed to their differing Q^2 ranges. However, the $\bar{\nu}$ data shows no sign of Q^2 dependence at small $x (x < 0.15)$ for the Q^2 range, $1 < Q^2 < 14\ (\text{GeV/c})^2$.

Many models of the EMC effect have attributed the rise at low x to an increase in the sea content of heavy nuclei [4]. The $\bar{\nu}$ data set very strigent restrictions on such a picture since $\bar{\nu}q$ and $\bar{\nu}\bar{q}$ scattering give rise to very different y distributions, such that $\bar{q}$ contribute strongly to the $\bar{\nu}$ cross section. An increase of sea in Ne compared to D_2 could lead to strong correlated changes in the ratios of the $\bar{\nu}\text{Ne}/\bar{\nu}\text{D}_2$ x and y distributions.

The effect of a 35% sea increase is shown by the full lines on all the figures. The data do not require such an increase. In fact, fitting the data gives the ratio of the the sea in Ne to that in D_2 as $Rs = 0.91 \pm 0.07$, as shown by the dashed lines (fig. 1). This conclusion remains true for a subsample of the data at higher Q^2, ($\langle Q^2 \rangle$) = 8 GeV/c^2 at $x = 0.075$) for which $Rs = 0.85 \pm 0.10$.

It has been suggested that nuclear shadowing may obscure any sea increase, even for $Q \simeq 8$ GeV/c . However, shadowing must be confined to very small x. One may cut the $\bar{\nu}$ data such that $x > 0.1$, and use the information in the x-y plane outside the shadowing region. The y distribution ratio would still show a rise for significant sea increase, but the data are best fitted by $Rs = 0.98 \pm 0.08$ (fig. 3).

It has also been suggested [5] that the difference between SLAC and EMC data derives from the fact that SLAC measures a cross section ratio and EMC measures an F2 ratio. At low Q^2, $R = \sigma_L/\sigma_T \neq 0$, and an A dependence in R as measured at SLAC [3], would imply ratios of $\sigma(\text{low } Q^2) \neq F_2(\text{high } Q^2)$. The $\bar{\nu}$, ν (preliminary) data can be used to investigate this question since $R \neq 0$ implies an extra (1-y) term in the ν, $\bar{\nu}$ cross section. For the $\bar{\nu}$ data this could cancel any effect from increase in sea in the $\bar{\nu}$ y distribution ratio (fig. 4) (dashed line $R = 0.08\ A^{1/3}$, dotted line $R = 0.1\ A^{1/2}$). However, an A dependence in R sufficient to cancel such effets completely, would appear in the $\nu\text{Ne}/\nu\text{D}_2$ y distribution as a slope which is not observed (fig. 4). Thus the $\bar{\nu}$, ν data together imply that there is no strong A dependence in R for this data, and hence the conclusion that there is no strong sea increase in heavy nuclei is maintained.

REFERENCE

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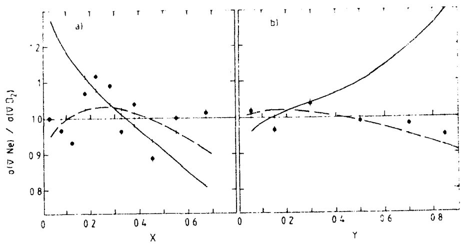

Fig. 1

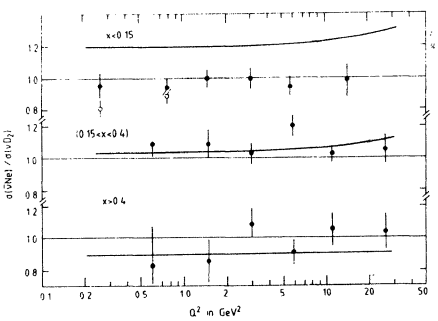

Fig. 2

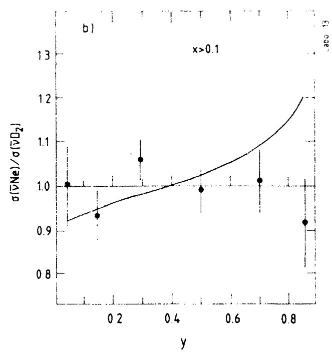

Fig. 3

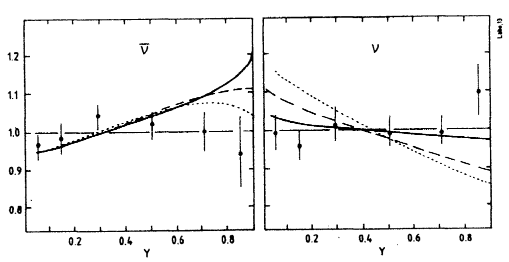

Fig.4